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# AREA IGNITION FOR BRUSH BURNING

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Improvement of brushland for livestock production has been expanding in California during the past several years. This program usually requires clearing the land of over-grown brush and then seeding or other cultural or management practices to increase the amount of usable forage. Although several methods of land clearing are used throughout the range area, fire has become the most common tool because burning requires a comparatively small cash outlay. Burning is a practical measure wherever it can reduce the brush without serious damage to other land or property values, or without excessive costs to prevent damages from occurring.

Meeting these requirements in California is not simple. Experienced men have been conducting controlled burns with outstanding success, but because the weather, vegetation, and topography in California brush areas are so varied that fires do not always burn the same way, there are times when fires either do not accomplish the intended job or they escape control. Adequate prescriptions for controlled burns under all situations will have to wait until more information on fire behavior is acquired.

In the meantime, the best promise for meeting the objectives of controlled burning lies in selecting a time to burn when easy control is assured and then firing in a way that develops maximum heat within the fired area. Area ignition applied during safe burning periods is one way to get the job done safely and effectively when experienced men are available to plan and conduct the burning.

## What Is Area Ignition?

Area ignition is the distribution of many individual fires over an area simultaneously or in quick succession. These individual fires must be spaced closely enough that they influence and support each other. Heat radiated by the closely spaced fires causes each to burn more intensely and the fuels between the fires to be heated and burn more rapidly. The many individual flame and smoke columns quickly join into one intense fire with a strong indraft which tends to keep the fire from running. This combination of mass-fire and strong indraft is called a "fire storm" (fig. 1) and begins as soon as enough heat is generated on a burning area to overcome the effects of local weather near the ground.

Figure 1. --Mass-fire with fire-storm effects.

The area ignition system of firing is particularly suited to land clearing on many California brush ranges. Because it produces effective results when burning conditions are such that fire from a single ignition spreads only slowly, an area-ignition burn can be scheduled for the less-dangerous periods of the year. Therefore, fewer men are needed, and less advance work around the area, to assure control of the fire. The method can often be used for burning out wide fire-control lines during off-seasons or at times of day when fire is easy to handle. Or area ignition can be used for burning out sections of planned burns during periods when control is easy; these burned-out sections minimize the threat of escape when the larger area is ignited.

Sometimes a fire-control line around the perimeter of an area is all the preparation needed for successful burning with area-ignition. More often, however, the method can best be combined with brush smashing in advance of burning. This combination has two purposes. It creates concentrations of fuel that can be ignited readily, and it makes the area accessible to a firing crew. Area ignition in smashed brush can yield good clean burns that would be difficult or excessively dangerous to obtain with other firing methods (figs. 2, 3). Such burns are over with quickly. Instead of depending on dry fuel, wind, and slope to carry the fire over an area, area ignition spreads fire at a controlled rate according to the needs of the situation. Burning can thus be accomplished within a planned span of hours.

Figure 2.--Area ignition on the right and conventional line firing on the left produced different results on this brush area.

Figure 3.--Area ignition in the foreground after smashing 40 percent of the brush. Unsmashed brush in background did not burn with conventional line firing.

Area ignition has been developed primarily as a way of firing areas on which the principal fuels are brush and brush litter. It should not be used everywhere. For example, it is not well suited to areas on which dry grass is the principal surface fuel. When conditions are such that the brush will ignite from fire in the grass, spread in the grass is usually fast enough that firing the perimeter actually results in area ignition. In such cases, firing from outside lines is just as effective and cheaper than area ignition.

## Mechanics of Area Ignition

Very small brush areas can usually be burned with the area-ignition method by scattering fire over the whole area simultaneously. On large controlled burns, however, firing must progress slowly enough that the area of mass-fire at any moment does not get dangerously large. In average brush this means not more than 5 or 6 acres.

Control can be maintained over the area of mass-fire that is burning at any time by recognizing four steps or stages in the process and regulating the speed of firing to keep the stages in balance (fig. 4).

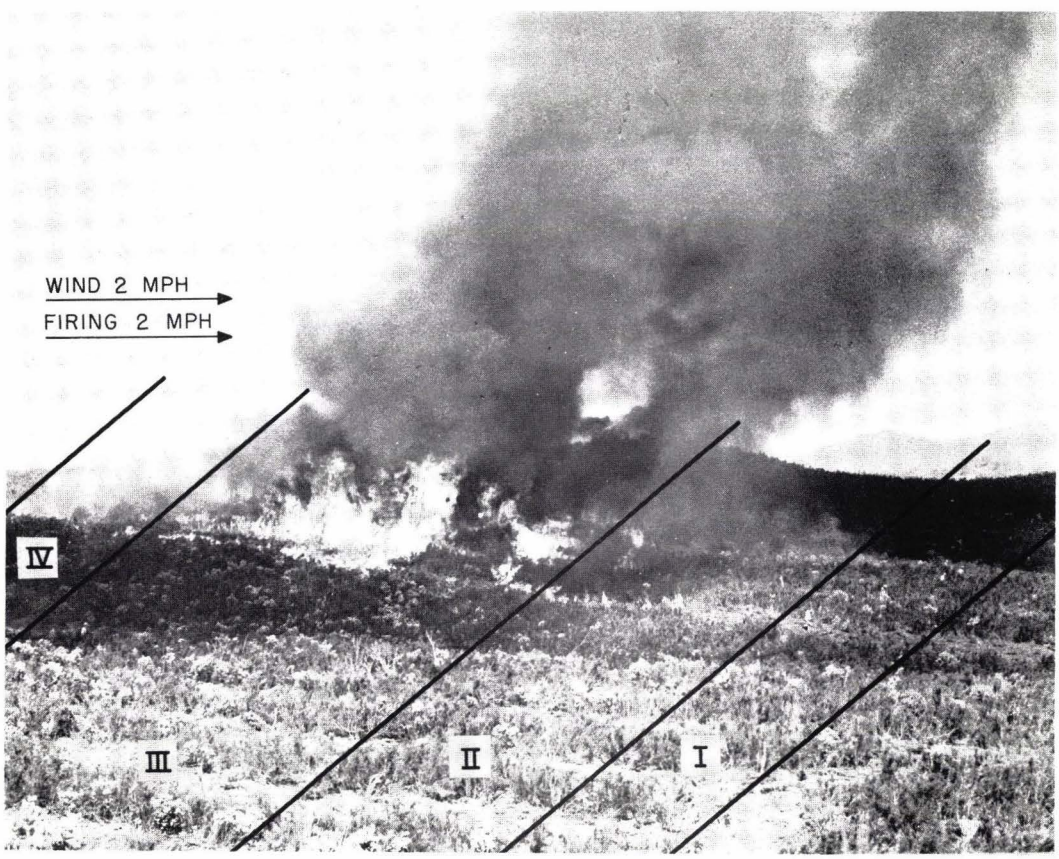


Figure 4.--In this controlled burn by area ignition, the crew is firing in band (I); individual fires are drawing together in band (II); the area of mass-fire in which all fires are joining into one is in band (III); and band (IV) is burned out and cooling off.

Area-ignition firing is usually done by a crew of men traveling in line and firing in parallel lines as they go. Behind them the four stages are as follows:

I. Ignition Stage

Individual ignition points become established and begin to spread.

II. Build-up Stage

Individual fires build up to the point where they begin to affect each other.

III. Mass-fire Stage

Radiation between fires and joining of convection columns into one produce fire-storm effects that last until the fuel is gone.

IV. Burn-out Stage

Fire dies out quickly and the burned area is cooled rapidly by indraft to the mass-fire ahead.

Under most conditions a firing crew traveling at 2 to 3 miles per hour will ignite the brush at about the right speed to maintain a safe and effective mass-fire area. Travel speed can be increased to enlarge the area of mass-fire, and thus the intensity of the fire, or slowed down to reduce it.

Brush Smashing for Area Ignition

Many brushland areas in California have so little dead litter on the ground that fire in them will usually burn clean only when burning conditions are extreme. Area ignition in these areas is handicapped because its successful use depends on having plenty of material that can be ignited rapidly. This condition has to be created if it does not exist before the firing begins. A further requirement for firing, until low-cost automatic igniting devices become available, is that there be easy and safe access for the men who must set the fire.

Experience has shown that smashing down the brush with a bulldozer in advance of firing makes ignition easier and access to the area safe. A bulldozer moving with the blade just above the ground surface breaks off green and dead branches and smashes them into a compact and easily ignited fuel bed. The broken green material dries in 2 to 3 weeks and may thus increase the amount of quick-burning fuel.

Smashing the brush adds to the total dollar cost of brushland improvement. The aim, therefore, should be the cleanest possible burn with the smallest smashed area. The ideal combination--one which produces a satisfactory burn at the lowest cost--varies with kind, age, and density of brush. Limited tests have been made using different smashing patterns and percentages of brush smashed (fig. 5) to find the most desirable combinations for different types of areas.

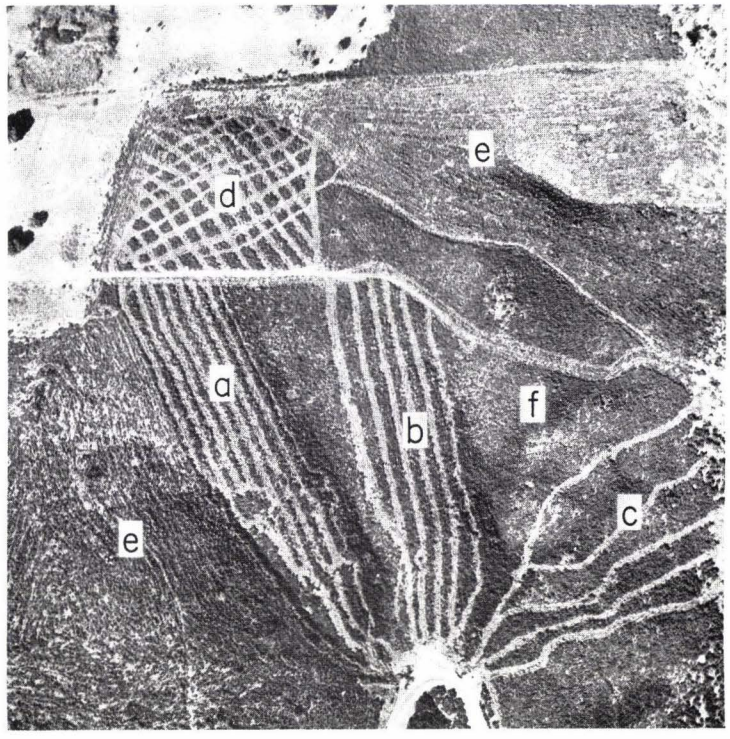


Figure 5.--Brush smashed with bulldozer for area ignition tests. (a) 50 percent of area smashed; (b) 33 percent of area smashed; (c) 25 percent of area smashed; (d) 50 percent of area smashed in gridiron pattern; (e) 100 percent of area smashed; (f) untreated brush.

Based on these tests, table 1 shows the recommended amount of smashed strips to use with the area-ignition system of firing on two types of California brush ranges, chamise and mixed chaparral. Because there have been only limited trials, the table should be used as a preliminary guide to judgment and not as a final answer. The recommendations assume that the actual burning will be done at a time when fire from a single ignition point will spread slowly but not run, and that drip torches or flame throwers will be used as igniters.

Some brush requires 100 percent smashing for successful area ignition. Complete smashing is particularly necessary in brush that is too young to have enough dead wood and litter on the ground to carry a fire. Complete smashing is also desirable where seeding and other range improvement work requires that the area be relatively free of stubs and snags. It also allows greater latitude in the time of burning and in size and spacing of the firing crew. The only reason 100 percent smashing is not recommended in all cases is that the immediate objective may not warrant the cost.

## When to burn

As in other methods of controlled burning, success or failure of area ignition depends on burning conditions at the time firing is done. If it is very dry or windy, or both, area ignition may be even more hazardous than conventional firing; on the other hand, when burning conditions are so poor that fire will not spread at all, area ignition may also fail. In general though, the range of conditions during which area ignition can be successful is wider and safer than with most other burning techniques.

All area-ignition burns should be planned to take advantage of weather conditions that favor this method and avoid those that are unfavorable. Fuel moisture, humidity, temperature, and wind should be considered together because no one factor can be used as a reliable guide.

Fuel moisture.--Plan area ignition burns for early spring before new brush growth starts or in late fall when fine fuels are damp. Spring burns are safer because grass is still green and spot fires will not start in grass. The best time of day for firing is usually middle to late afternoon or early evening--the time when moisture content of large dead material (2 or more inches in diameter) usually is low and moisture content of fine dead material is increasing.

Table 1.--Preliminary guide for brush smashing to use with area ignition [1/]

| Brush condition | Brush density [2/] | Percent of area to be smashed |
|---|---|---|
| Young, brush growing vigorously, few dead twigs and leaves, litter on ground will not carry fire. | open | 100 |
| | medium | 100 |
| | dense | 100-50 |
| Mature brush plants which have attained maximum height, visible dead twigs and branches in crown, litter on ground will carry fire under normal summer burning conditions. | open | 100 |
| | medium | 50 |
| | dense | 33 |
| Over-mature brush plants with crowns beginning to thin, many dead twigs and branches, litter on ground will carry fire whenever it can be ignited. | open | 100 |
| | medium | 33 |
| | dense | 25 |

1/ Assumptions:

1. Chamise and mixed chaparral type in California.
2. Burning conditions such that fire from a single ignition spreads only slowly. Spot fires will not run.
3. Average size of main brush stems is between 1 and 4 inches.

2/ Open--brush crowns cover 20-50 percent of ground surface.

Medium--brush crowns cover 50-80 percent of ground surface. (Men can walk through area with difficulty by picking their way.)

Dense--brush crowns cover more than 80 percent of ground surface. (Almost impossible to walk through area.)

Humidity. --Plan to burn when relative humidity is between 30 and 50 percent. When humidity is more than 60 percent, burns are rarely effective; conversely, at less than 25 percent, fast-spreading fires often run and produce excessive spotting.

Temperature. --Plan to burn when air temperature is less than 90° F.

Wind. --Dead calm is best for area ignition where dry grass is present. Dead calm to very light winds, less than 3 miles per hour, are required for effective area ignition in light to medium brush. Steady winds up to 5 miles per hour can be tolerated in heavy fuels. Winds of 10 miles per hour or greater have invariably led to unsatisfactory burns--through failure to develop fire-storm effects--or through escape.

## Precautions

Area ignition is at present an art which requires experience and judgment for successful application in land clearing. It is intended for use at times when fire danger is low. If used when burning conditions are severe enough that single-point or line-set fires will build up and run, area ignition can be dangerous. Until further research and experience can outline precise specifications or until an individual becomes skilled in its use, area ignition should thus be limited to controlled burning under the following circumstances:

> ...burning conditions are low or moderate (as indicated by low rate of spread from a single start).
>
> ...more than 50 percent of the surface area in mixed grass and brush types is covered by brush crowns.
>
> ...rate of firing will restrict fire-storm effects to not more than 5 acres at a time.
>
> ...wind velocity is less than 5 miles per hour.
>
> ...conducted by a person experienced in conventional means of using and controlling fire.